



# Fact Sheet

US Army Corps of Engineers  
U.S. Army Engineer Research and Development Center

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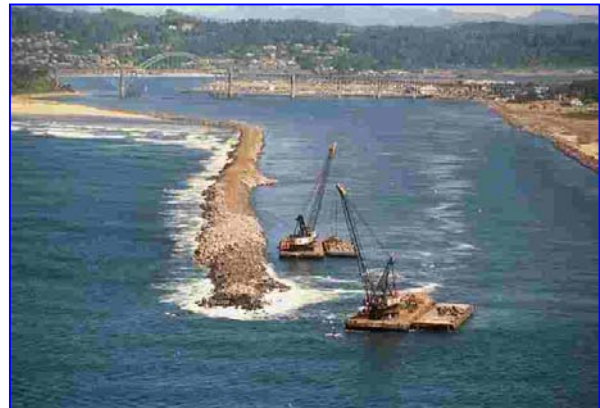
Public Affairs Office □ 3909 Halls Ferry Road □ Vicksburg, MS 39180-6199 □ (601) 634-2504 □ <http://www.wes.army.mil>

## Prediction and Prevention of Rubble Mound Structure Damage

**Purpose:** Develop empirical equations for predicting deterioration of coastal rubble mound breakwaters, revetments, and jetties.

**Background:** The Corps of Engineers maintains over 500 coastal structures. Most of the structures are rubble mounds and most have exceeded their intended lifetime. Many are in need of repair. Replacement cost on these structures is on the order of \$10M to \$100M. Most of these structures sustain small amounts of damage each year because they were built to be “flexible” under extreme storm conditions. There are few tools available to predict damage development to coastal rubble mound structures.

There are no math models available to predict damage to large jetties, which are vital to maintaining the nations channel entrances.



**Facts:** This research effort is focused on developing tools for predicting armor stone movement on coastal rubble mounds. Initial products from the effort included high-speed robotic laser profilers that are used to profile small-scale coastal structure models in the laboratory. Historically, rod and level surveys of structures in the lab were cost prohibitive and yielded spatially and temporally crude measurements. With the new profiling technology, profile measurements are done at very high spatial and temporal resolutions. The data have resulted in improved understanding of armor stone movement. Measurements from this technology have led to new empirical formulas that predict the rate of stone movement on breakwaters, revetments and jetties exposed to a series of storms. Further, equations for predicting the variability of damage along the structure and the variability in time have been developed. The relations are the first equations of this kind and are crucial for performing life-cycle analyses of structures. This research has led to a more physics-based approach to armor stability. The result is reduced costs of design, more reliable designs, and an ability to predict damage.

**Points of Contact:** For additional information, please contact Dr. Jeffrey A. Melby at 601-634-2062 ([jeffrey.a.melby@erdc.usace.army.mil](mailto:jeffrey.a.melby@erdc.usace.army.mil)), or Mr. Dennis G. Markle at 601-634-3680 ([dennis.g.markle@erdc.usace.army.mil](mailto:dennis.g.markle@erdc.usace.army.mil)).